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THE COMPARATIVE MERITS OF THE NITRATE OF SILVER AND
SULPHATE OF COPPER IN CERTAIN FORMS
OF CONJUNCTIVITIS.

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Of all the therapeutical agents which the materia medica contains, perhaps there is none which, as a topical remedy, has been more immoderately praised, on the one hand, for its alleged virtues, or more severely censured, on the other, for its alleged injurious properties, than the nitrate of silver. This diversity of opinion, as would be naturally inferred, exists in a very marked degree among those who have paid particular attention to diseases of the eye, since it is in these diseases that it is most commonly, or at least very frequently, employed, and where, consequently, its good or bad effects, as they are most manifest, are more easily recognized, and therefore more remarked upon.

Now as this difference of opinion is founded, not on theory, but on the different results which have followed its application to the same class of disease; and as the remedy in both cases was the same, it is reasonable to infer that the difference of result was due not to the remedy itself so much as to the manner in which it was employed; and that this difference in the mode of application is the true explanation of the success which attends its use in some cases and of the ill effects which follow it in others.

In order to understand the therapeutical effect of any drug, and to obtain its most beneficial influence on the one hand, and avoid its injurious effects on the other, it is necessary to take into consideration the anatomical and physiological nature of the part to which the remedy is to be applied, when in a state of health—then the chemical and physiological properties of the remedy and what effects follow its application to the healthy tissue. These two questions having been decided, it remains then to observe what anatomical and physiological changes have taken place in the part under the morbid action, and to determine, as far as possible, how far these abnormal conditions are influenced by the remedy proposed.

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It is this method of investigation which I propose to follow, as far as I am able, in considering the effect of nitrate of silver when applied to the conjunctiva.

The mucous membrane of the eye is similar to other mucous membranes in structure. Though a perfectly continuous membrane, extending from the free border of the upper lid to that of the lower lid, it may be still divided, for convenience of description, into three parts, according to the region which it covers, viz., the conjunctiva of the lids, or palpebral, that of the cul-de-sac, and that of the globe. According to the most recent investigations, the conjunctiva may be considered as composed essentially of two parts—(1) a superficial portion, the epithelium; (2) a deeper portion, consisting of an uniform couch of cellular tissue, which, from the manner in which its elements are arranged, is called the papillary body.

The mode of union between the papillary body and the tissues lying beneath it varies in different regions. Over the tarsal cartilages it is connected by a thin but close layer of cellular tissue, which permits but a small amount of extension, while in the cul-de-sac, the cellular tissue being arranged in the form of a network of large meshes and of a loose construction, the conjunctiva in this region is capable of being greatly extended, though, at the same time, it possesses but a slight degree of elasticity. The papillary couch, or basement membrane, grows thinner and thinner as it advances over the globe until just before it reaches the cornea, when it becomes, with the exception of a sort of fold known as the conjunctival ring, an exceedingly thin layer of cellular tissue with no distinct papillæ, merging gradually into the substance of the cornea. The papillary body, as a whole, is composed of a firm layer of cellular tissue, which gradually fuses itself, with no defined limits, with the subconjunctival tissue beneath. On that portion of the tarsal cartilage which is nearest to its free border the papillæ are hardly visible; towards the posterior border of the cartilages they become more prominent, while in the cul-de-sac, though they are larger at their base, they are not so much raised above the level of the surrounding tissue. The papillæ themselves which compose the papillary body are formed of simple cellular tissue and possess a considerable degree of solidity. The vessels of the conjunctiva are very numerous, the capillaries forming an irregular network of curved vascular loops, which extend over the free surface and within the papillæ.

Besides the anatomical structures above mentioned, the conjunctiva, as a whole, contains many others, such as lymphatic vessels, acini, and Meibomian glands, nerves, &c., a minute description of which, although they must necessarily play a most important part in any condition of the conjunctiva, either normal or abnormal, is not necessary for the purposes for which this article is written. In regard to the sensibility of the conjunctiva, it will be sufficient to say

that the portion which covers the globe, owing to a greater distribution of the nerves, is the most sensitive, while at the same time it is the least vascular.

It is very doubtful whether the vessels of the papillary body of the conjunctiva, in a normal condition, empty any perceptible amount of serous liquid into the conjunctival sac, as often happens in pathological conditions, after the partial elimination of the epithelial layer, as, for example, in blenorrhœa. Probably the network of loop-shaped vessels, situated very near the surface of the mucous membrane, is necessary in order to facilitate the reproduction of the epithelial cells in proportion as they are eliminated, and while these vessels furnish the albuminous material necessary for this, they could not pour out, at the same time, a notable quantity of aqueous fluid, because this liquid would constantly wash away the cells of new formation.

The epithelial cells decomposing themselves at the surface of the conjunctiva form a viscous liquid, with some amorphous granules, which, in part only, contain fat and constitute essentially what is called the mucous secretion of the conjunctiva.

Such is the anatomical arrangement of the conjunctiva in a state of health. It now remains for us to consider the changes which take place under morbid influences, and in what manner the therapeutical agent which we have under consideration influences these morbid conditions.

Inflammation of the conjunctiva, or conjunctivitis, may vary in degree from the slightest congestion of the vessels to an intensified inflammation involving the deeper structures, accompanied, or followed by, an abundant purulent discharge. It is to this latter condition, known generally as purulent ophthalmia, that our attention will be chiefly directed, for it is to this condition, in its different degrees, that we believe the virtues of the agent under consideration to be chiefly adapted. It is often very difficult to determine exactly the difference between purulent conjunctivitis and acute catarrh, and, in the absence of any anatomical proofs which would enable us to separate the two, we are forced to consider one but an aggravation of the other. Still, though this difference be one of degree and not of kind, there are generally symptoms accompanying each variety which enable us practically and for therapeutical purposes to distinguish one from the other, and so determine the condition under which our remedy is to be applied.

Purulent conjunctivitis differs from acute catarrh inasmuch as

- (1.) The injection of the vessels and the serous infiltration is much more marked in the former than in the latter.
- (2.) The prominence and turgescence is greater.
- (3.) The quantity of a purulent secretion is much more abundant.
- (4.) The complication on the part of the cornea is very frequent in the purulent, very rare in acute catarrh.

Another most important distinction between these two varieties of the same disease, is the seat of the inflammation and the character of the secretion. The inflammation in acute catarrh is a superficial one, and is characterized by a more or less rapid elimination of the most external layers of the epithelium. Under the unnatural stimulus of the morbid action successive layers of new cells are too rapidly produced to admit of their being completely formed, and in the place of fully-developed epithelial cells we find a large quantity of globules of mucus or of pus, according to the degree of development, the pus-globule being but the rudimentary stage of the mucous, and the mucous that of a true epithelial cell. But in purulent conjunctivitis the inflammation is greater in degree and no longer affects the conjunctival tissue alone, but extends to the subconjunctival ones, and the rapidity of the formation of new cells, in order to replace those which have been destroyed by the morbid process, is in proportion to the extent of the disease and its violence. From this it results that the quantity of undeveloped cells, globules of mucus and pus, will predominate over the more fully developed ones, and these undeveloped cells (and the more rapidly they are formed the less developed will they be) mixing themselves with the liquid, which is abundantly poured out by the diseased mucous membrane, constitute the secretion which is characteristic of the disease—a secretion which is essentially purulent, while in the secretion from acute catarrh, where the inflammation is less, the more fully developed mucous globules will predominate, and the secretion will then be muco-purulent in character.

In examining an eye which is affected with purulent conjunctivitis, we observe that there is a general swelling of the conjunctiva, but what most particularly attracts our attention is the increased size of the papillæ, which have assumed the form of small tubercles pressed laterally against each other with considerable force, on account of their turgescence. The color of these tubercles varies from a deep red to that of a reddish blue, though later in the disease, and especially when it passes into a chronic condition, the color is rendered much paler by the thickening of the epithelial layer. This hypertrophy of the papillæ of the conjunctival tissue is limited principally to the palpebral portion. In the cul-de-sac they are so closely pressed together that it is impossible to distinguish the conjunctiva beneath them. Towards the angles of the eye the papillæ have the greatest amount of development. In examining the surfaces of these papillæ, we do not perceive any small injected vessels which would account for their deep red color; and the fact that they bleed on the slightest pressure is entirely due to the papillæ themselves being gorged with blood, rendering it impossible to see the vascular network of the conjunctiva beneath.

In examining these diseased papillæ with a microscope, we find a more or less thickened layer of epithelial cells, the deepest of which

are cylindrical in form, and contain, embedded in a mass of granules, a large oval nucleus. M. Stellwag asserts that the extremities of these cells grow finer and finer the more we advance into the interior of the papillæ, though this has been doubted by others. Beneath this layer of epithelium, which is by no means clearly limited or defined, we find an intercellular mass more or less granular in character, and beneath this again we observe here and there the fibres and fibre-cells of the conjunctival tissue. Through this fibro-cellular mass, with which a quantity of nuclei and cells of new formation is mixed up, a multitude of vessels run and ramify, forming round the base of the papillæ a network of considerable closeness and density. It is this great quantity of cells of new formation and nuclei which determine that the pathological change which has taken place is a hyperplasia of the cellular tissue of the papillæ, and that the swelling of the tissue is not due solely to a serous exudation, but also to a general increase of the elements of the cellular tissue which surrounds the vessels of each papilla. While this increase of the cells of the conjunctival tissue is going on, the same increase takes place also in the intercellular mass. The exact change which takes place in the tissue, when subject to the morbid influences under consideration, is then an alteration in an *anatomical element* pre-existing in the conjunctiva, with hypertrophy of the cellular tissue which forms that element. There is not in this case any *neoplastic* formation, a fact which distinguishes it essentially from a form of conjunctivitis with which it has often been confounded, both in diagnosis and treatment, and which is known as granulations, trachoma, &c., which are not, as this is, a simple hypertrophy of a pre-existing element, but which are, in reality, a new formation, differing essentially in anatomical construction from that of the tissue among which it is found.

As the result, then, of the morbid influence, we have distension of the lid, sometimes so great as to remove all the folds of the skin, caused, firstly, by serous infiltration into the loose and yielding cellular tissue of the subconjunctiva, and, secondly, by a hypertrophy of the cellular tissue of the conjunctiva itself, which is much thickened, ragged, but soft and flabby, and of a deep red color, and prone to bleed at the slightest touch. This is accompanied by an abundant homogeneous discharge.

The complication on the part of the cornea should not, strictly speaking, be considered as a part of the disease, as they are simply the result of it, and are caused by the strangulation (from the pressure of the exudation) of the vessels which nourish this membrane. Such, then, being the anatomical and pathological nature of the disease, we will pass to a consideration of the remedy proposed for its treatment.

One of the most important characteristics of nitrate of silver is its great solubility in water, as we are enabled, by graduating the strength

of the solution, to obtain any effect, from that of the mildest local stimulant to the complete destruction of the part to which it is applied. Water is capable of solving its own weight of the nitrate, so that the prevailing idea, that a solution containing sixty grains to the ounce is a saturated one, is a mistake. Though we are enabled, by varying the strength of the solution, to obtain various effects, still, nitrate of silver in itself is, strictly speaking, a caustic, destroying the tissue to which it is applied by entering into chemical combination with the constituent elements of the tissue, uniting with the albumen and fibrin to form compounds which are exceedingly insoluble. Authors differ very much in regard to exactly what these new albuminous compounds are, many asserting that they have, in fact, no definite chemical composition.

Though there is this difference in regard to the exact composition of the albuminates formed, all admit that such albuminates are formed, and that they are exceedingly insoluble—and it is in a great measure on this insolubility of the albuminate that the action of the drug depends.

The conventional properties attributed to all medicines of this class, of being "stimulant, astringent, and alterative," have also been given to nitrate of silver, though in point of fact it is entitled to none of them. Its action is simply that of an irritant, and the different properties attributed to it are but different degrees of irritation. It certainly does produce contraction of the bloodvessels, though it does so secondarily through the nerves, for in such cases, according to Virchow, the sensitive nerves stand in the same relation to the bloodvessels as to the nerves of muscular motion; and it is by means of this relation that irritating and stimulating agents produce contraction of the bloodvessels.

When applied to the mucous membrane, nitrate of silver combines with the outer layer of the epithelium, forming a white film, which is caused principally by the union of the salt with the albuminous matter of the tissue, though in part, also, by its reaction with the chloride of sodium. The production of this white film by no means implies that an escharotic effect has been obtained, as this will take place even with a solution which is much too dilute to attack the constituent parts of the tissue. That amount of irritation generally known as the "stimulating and alterative effect," is produced by a solution varying in strength from one grain to three of the salt to one ounce of water, while the true escharotic effect is produced by a solution of one to three drachms, or even more, to the ounce of water. A great deal has been said, and justly, of the self-limited action of the nitrate of silver, which is attributed to the fact that when it comes in contact with the tissues it forms an insoluble compound which prevents any excess of the undecomposed salt from penetrating to the tissue below. Now, though this is not always absolutely the case, it is, generally speaking, and the great

danger from the use of the nitrate of silver lies, not so much in its excessive use at any given time as in its frequent repetition. As has been often remarked, one of the principal objections to the use of nitrate of silver is the peculiar discoloration which it gives to the tissue, and which is often a great deformity. But this discoloration is by no means a necessary accompaniment to the use of the medicine. It arises, not from its application, but from the manner in which it is applied. The fault lies not in the agent, but in the administrator. Exactly to what this discoloration is due is not known. Patterson supposed that, a chloride having been formed, this was decomposed by the light, and metallic silver was deposited among the tissues; while, according to Brandes, the metal exists as an oxide, and to Krahmer, in combination with albumen as an albuminate. Mr. Sydney Jones and Fromman have more recently obtained metallic silver in the tissues.

Such being the chemical and physiological action of nitrate of silver when applied to the mucous membrane in a state of health, let us now consider its effect when applied to the same tissue under the morbid condition known as purulent conjunctivitis, or ophthalmia.

The best method of applying nitrate of silver in conjunctivitis is by means of a solid composition consisting of two thirds of the nitrate of potassa and one third of nitrate of silver. By using the nitrate in this form, we are enabled to confine its action to the whole or any part of the palpebral portion of the conjunctiva, and so govern its effect in proportion to the violence of the disease. This is extremely difficult with solutions, which should only be used when the stick cannot be obtained. The lids should be turned out, so that as much of the conjunctiva of the cul-de-sac should be exposed as possible. The lids should then be touched with the crayon, more or less thoroughly, according to the violence of the inflammation, the thickness of the epithelium, and the amount of blood which follows their eversion. Most of the foreign writers recommend that, after the lids have been touched with the nitrate, they should be bathed freely with a camel's-hair brush dipped in a solution of salt and water, in order that the excess of the caustic may be neutralized by the chloride of sodium. The efficiency of this we doubt, as the action of the caustic is a very superficial one, and if, by chance, there was an excess of the salt neutralized in this way, an insoluble compound, chloride of silver, would be formed, which, in the absence of the epithelial layer, might penetrate to the tissue beneath and add materially to the chances of producing that discoloration of tissue which has always been one of the chief objections against the use of this agent.

After a light application in the above manner, we observe that almost immediately a white film, or eschar, is formed, varying in thickness and extent, according to the length of time that we have allowed the nitrate to remain in contact with the tissue. In a short

space of time, proportionate to the degree of inflammation and the vascularity of the part, the eschar begins to be eliminated in bands and flocculi, accompanied by an abundant exudation and an increased flow of tears mixed with globules of mucus. The elimination on the tarsal cartilages, if the conjunctiva is very puffy, will be effected in from fifteen to twenty minutes. In the cul-de-sac it remains attached somewhat longer, perhaps on account of the anatomical construction of the part, but at the end of thirty minutes, or at most an hour, the elimination is complete. During this period the temperature of the eye is considerably elevated, the pain is increased, and the lids, greatly distended, can be opened only with great difficulty, or perhaps not at all. This period, or period of elimination, is followed by a second, in which the epithelial layer, which has been removed with the eschar, is reformed. During this second stage the turgescence of the mucous membrane and the swelling of the lids become less, and the muco-serous and purulent discharge diminishes, accompanied by a corresponding decrease in all the inflammatory symptoms. This diminution in the secretions and abatement in the inflammatory symptoms lasts until the epithelial layer is entirely reformed, when they gradually increase, and the disease would again assume, if left to itself, the same condition which it presented before the application. In order to prevent this, we again apply the nitrate, and the same elimination of the eschar and reformation of new epithelium then takes place, while we observe that the length of time between the elimination of the eschar and the formation of the new epithelial layer becomes greater and greater as we repeat the application, and that the swelling and turgescence of the mucous membrane diminish. The tendency which the disease has to assume its third, or purulent stage, also grows proportionately less till it finishes entirely, and the whole tissue returns gradually to its original healthy condition. The advantages of this method of applying the nitrate of silver over that so much in vogue at one time, and in use even now to a great extent, cannot fail to be apparent—a method which consisted in literally pouring strong solutions of this salt into the eye. If there is, in these cases, an abundant purulent secretion, the solution is in the first place very much weakened by decomposition, and is then almost immediately carried from the eye. But if the solution succeeds in reaching the mucous membrane, this mode of application necessitates its coming in direct contact with that part of the conjunctiva which is but affected in a secondary manner, and which is the most sensitive, on account of the quantity of nerves which it contains, while that part of the membrane which is the principal seat of the disease receives but a very scanty and superficial application. This manner of administration is exceedingly painful, and the eschar which results from it, as it is formed principally on that portion of the conjunctiva which is always the least turgescient and vascular, is consequently

eliminated very slowly and with great difficulty. From this it results that the epithelial layer is often regenerated on the palpebral portion, while the eschar still remains on the conjunctiva of the globe.

Another very serious consequence of its application in this manner, is the elimination of the epithelial layer of the cornea, a complication which interdicts its further use. All of these objections, and others too numerous to mention, are entirely obviated by its use as presented above. If the crayon cannot be obtained solutions may be used, but great care must be taken that the lids should be thoroughly everted, while the patient should be directed to close his eyes, which will bring the cul-de-sac of the two lids in apposition, and prevent the solution from penetrating to the conjunctiva of the globe. The solution should be applied with a camel's-hair brush, and the lids should then be freely washed, as before directed in the case of the crayon, in order to remove what remains of the nitrate undecomposed by contact with the tissue, so that as little as possible of its action should extend to the globe when the lids return to their place.

The most important consideration in the employment of nitrate of silver, and the one most difficult to determine, is the exact time when the application should be renewed. In this respect two errors are generally committed—either the application is made too soon, or it is delayed too long. If it is repeated in too short a time after the elimination of the eschar and before the epithelium has been regenerated, the nitrate then comes in contact with the mucous membrane while denuded of its epithelial layer, and the salt then penetrates the tissues beneath, and there, from the force of its action on the unprotected parts, will either produce cicatrices which will be of lasting detriment to the eye, or, becoming decomposed by coming in contact with the chloride of sodium, which exists in greatly increased quantities among the diseased tissue and secretions, will form an insoluble compound (chloride of silver)—and this being entangled and incorporated amongst the tissue, will leave an indelible stain. If, on the other hand, we allow too much time to elapse between the applications, and so permit the disease to regain its former violence, it is evident that the second application will but produce the same effect as the first, and but little or nothing will be gained.

The exact time, then, to use the nitrate of silver is not immediately after the elimination of the eschar, when the membrane is denuded, but when, after a sufficient lapse of time, the epithelial layer has been regenerated completely, but, at the same time, before the swelling of the conjunctiva has re-commenced, and before the amount of the secretions can become as abundant, and the general inflammatory symptoms as severe, as they were before the application. It is only when employed under these conditions that the caustic is capable of producing good effects without running the slightest risk

of injuring the deeper portions of the conjunctival and subconjunctival tissue. In order to determine the moment in which the succeeding applications should be made, it is safer to rely not on the increased swelling of the mucous membrane, which is very difficult to determine, but rather on the increased amount of the secretions and congestion of the eye, which begins to take place just after the epithelium is regenerated, and this is precisely the moment in which the use of the nitrate is indicated. Usually it is sufficient to make but one application in twenty-four hours, but the frequency with which they should be made is in direct relation to the turgescence of the mucous membrane and its vascularity. There are cases in which this is so great that the elimination of the eschar, the re-formation of the epithelium, and the re-installment of the third stage follow each other so rapidly that the applications must be made twice a day. While on the other hand there are cases where the turgescence and vascularity are so slight that on account of the tardy elimination of the eschar it is only necessary to apply the caustic once in thirty-six or forty-eight hours. I have seen a case of undoubted purulent ophthalmia where the crayon had to be applied but once, the eschar not being entirely eliminated at the end of four days, when the mucous membrane was no longer in a condition to need it.

It will be readily understood that, as the disease abates, the applications will become less and less frequent.

Another most important consideration in regard to the employment of nitrate of silver is, whether it should be used when there is any complication on the part of the cornea. There can be but little doubt that as long as the purulent conjunctivitis exists it would be useless to hope of curing the affection of the cornea, which is but the result, not necessarily a part, of the disease. The best mode of curing the secondary trouble is first to get rid of the primary cause, only great care should be taken that the nitrate should be applied only to the palpebral portions, in order that the eschar may be quickly eliminated; and care also should be taken that all excess of the salt should be removed by repeated washing with the brush dipped in cold water. The slight and temporary friction on the cornea resulting from the eschar is more than counterbalanced by the good effects of the nitrate.

Such, then, being the clinical results which follow the application of nitrate of silver to the diseased conjunctiva, it remains to be seen in what manner these results are produced, and how far they can be explained by the chemical and physiological properties of the remedy under consideration.

The application of caustic agents, or even of strong astringents, to the mucous membrane when in a state of active inflammation has long been considered detrimental, though we have high authority for their use. Hunter, under some conditions, strongly advocated this method

of "substitution," and Shakspeare, whose knowledge of "all the ills that flesh is heir to," though intuitive, was as exact as it was varied, not only approved of it, but prescribed it:—

"Tut, man, one fire burns out another's burning;

One pain is lessened by another's anguish.

Take, then, some new infection to thy eye

And the rank poison of the old will die."

Still, notwithstanding this high authority, it is only at the very outset of the disease, and when the diagnosis is perfectly certain, that the so-called abortive treatment is now resorted to by skilful practitioners. And as the nitrate of silver, when used in this way, is rather a preventative of the disease than a remedy for it, a consideration of its effect, when so employed, does not come within the purposes for which this article was written. We shall pass, therefore, at once to the consideration of its effect when applied to the diseased mucous membrane.

In inflammation of the conjunctiva, as in all inflammations, there is a great increase in the metamorphosis of the tissue and an increased flow of blood to the part, for the purpose of repairing the waste occasioned by the inflammatory process. By this increased flow of blood new material is rapidly passed, through the capillaries, to the tissues, and is rapidly elaborated to supply what has been consumed by the morbid action. In the very first stages of the disease, when the inflammation is so slight as to amount to little more than light irritation, just enough of new material is elaborated to take the place of what has been consumed, and there is very little if any increase in the normal amount of the secretion; but when the morbid action increases in violence the new material is passed to the tissues in such quantities, and is, under the unnatural stimulus of the disease, elaborated so rapidly, that the cells of new formation and epithelial cells cannot be fully developed, so that, in this unformed condition, they are rapidly eliminated, as pus and mucous globules, in successive layers from the mucous membrane. These, mixing with the other secretions of the eye, form the secretion characteristic of the disease, which is, at the beginning, of a muco-purulent character, but which soon becomes, from the preponderance of pus globules, essentially purulent. By this unnatural determination of the blood to the inflamed spot, and increased rapidity of the circulation, the walls of the capillaries are subjected to an increased and unnatural pressure, which causes them finally (when this becomes disproportionate to their power of resistance) to become distended. As a physical consequence of the dilatation of the vessels there takes place a retarded flow of the blood, which, together with the relaxation and dilatation of the vessels, favors the exudation of the serum into the loose cellular tissue. The consequence of this is, that the lids become enormously distended. It is in this relaxed state of the vessels and oedematous condition of the cellular tissue, accompanied

by a profuse discharge—a state where the acute inflammatory symptoms seem to have passed, with a contemporaneous diminution in the pain which usually accompanies the first stage—that we are most commonly called upon to treat the disease, and it is precisely under these circumstances that the nitrate of silver shows its peculiar merits. When applied to the mucous membrane it forms, with the albuminous products of the secretions and the diseased epithelial layer, a firm, insoluble coagulum, in which are entangled the half-developed cells of new formation, pus and mucous globules, and which adheres with considerable tenacity to the projections of the papillæ beneath. By the irritating effect of the nitrate on the nerves of the part it causes the relaxed vessels to contract, giving tone to their walls, which causes the circulation, which had been retarded, to be once more set in motion, and though the swelling and pain are for a little while increased by the irritating effect of the caustic, both soon subside, and re-absorption begins to take place. By the adherence of the coagulum, the cells of new formation are not eliminated the moment they are formed, and so time is given for their fuller development, and the secretion, which is temporarily stopped by the presence of the coagulum, when this is finally eliminated, is thicker and more mucous in character than it was before the application. It is upon this property of forming a dense and insoluble coagulum that the excellence of nitrate of silver over other irritating astringents depends. Besides the stimulating and astringent effect which it produces upon the vessels of the part, the coagulum which it forms takes the place for a time of the epithelial layer, preventing the escape of the incompletely-formed material, and, when the eschar does finally separate, it takes with it the diseased debris of the old epithelial layer, and although this leaves the surface beneath denuded, it leaves it, by freeing it from morbid collections, in a condition much more favorable to the reproduction of a new and more healthy epithelium.

Among the multitude of therapeutical agents which have been proposed as substitutes for the nitrate of silver, the only one which is worthy of special remark is the sulphate of copper in the solid form; for if the other remedies suggested are, on the one hand, free from the defects of the nitrate, they certainly are, on the other, destitute of its virtues. In regard to the salutary effect of the sulphate of copper in certain diseases of the conjunctiva, and its superiority in these diseases over the nitrate of silver, I have not the slightest doubt; and I must say, in justice to its merits, that I have seen some wonderful effects follow its use. But, as these results were obtained by one whose skill in the treatment of diseases of the conjunctiva is justly renowned, I cannot help thinking that the effect produced was rather due to the skill with which the agent was applied than to any inherent virtue of the remedy itself. Besides, the cases to which I refer were mostly of one description, and of that class,

in the treatment of which, as will be seen further on, I admit the superiority of the sulphate of copper over the nitrate of silver, or, indeed, over any other agent.

There seems to be a diversity of opinion among authors in regard to the chemical and physiological action of sulphate of copper on the tissues. Stillé, in his therapeutics, asserts, that when "it is applied to a wound or ulcer it coagulates the albumen by combining with it in the manner of an astringent, but it has no destructive or caustic action." But a little farther on he adds, "when the dose has been very large and fatal, after a considerable interval, ulceration and sloughing of the bowels have been found, and even perforation of the peritoneum." These two statements do not appear to be consistent. The same author, in speaking of the different action of irritants, says, "Mr. Bastick (*Times and Gazette*, April, 1858) has proposed a division of caustics into two classes, and this division appears to be well founded. One class comprises those which merely kill the tissue, as the chloride of zinc, sulphate of copper and zinc, &c.; the other includes those which also decompose the tissue, dead or living, as caustic potassa, nitrate of silver, &c. Agents of the first class also become antiseptics, or preservatives of the tissue, whose vitality they have destroyed, while those of the second form new compounds out of its elements, as potassa does with the fibrin and albumen of the part." If this division is "well founded," how is it possible for the sulphate of copper to belong to any class of caustics when it "has no destructive or caustic action"? And if "it preserves the tissue whose vitality it has destroyed," how is it possible that ulceration and sloughing of the bowels, and even perforation of the peritoneum, have been found?

In opposition to the above opinions, Pereira maintains that its topical action depends on its combination with the constituent elements of the tissue, and that it forms with the albuminous compounds a greenish-white coagulum. Mitschenlich agrees with this opinion. But Lassaigne says that the albuminous compound formed is of a bluish whitish tinge, and results from the union of albumen with the sulphate of copper, while Mulder affirms it is due to its union with the oxide. According to Robin and Verdeil, the true change which takes place is one which is analogous to that which occurs with the nitrate of silver in the presence of albuminous compounds. The salt is decomposed; albuminate of copper on the one hand is formed, and sulphate of albumen on the other, and these two compounds unite to form a third. Now, although as with the nitrate of silver, there is some doubt as to the exact chemical composition of the coagulum formed, there is no doubt that it is formed, and formed at the expense of the albuminous element of the tissue. This coagulum differs very much from that formed by nitrate of silver under similar circumstances in quantity, density and solubility, the sulphate of copper forming with albumen, according to Thomp-

son, a very delicate precipitate which, though insoluble to a degree, is, according to the above-named author and Lieberkuhn, easily soluble in an excess of the salt.

Sulphate of copper in the solid form is a powerful irritant and escharotic, and it is highly probable that, while part of its action is, as above stated, on the constituent elements of the tissue, by far its greatest effect is upon the nerves of the part, acting as all irritants, when used in moderation, do as an astringent, giving tone to the walls of the capillaries and increasing the rapidity of the circulation.

Clinically speaking, when applied to the diseased conjunctiva, instead of producing the dense and firm coagulum characteristic of the nitrate of silver, the adherence and elimination of which are followed by such good results, the effect of the sulphate on the albuminous compounds is so slight as almost to escape detection, and the coagulum really formed is immediately eliminated in minute flocculi, which flow away with the secretions without removing to any extent the morbid collections, and, consequently, without leaving the surface beneath in so favorable a condition, as the nitrate does, for the re-production of the new epithelium.

Thus, though the chemical and physiological action of the nitrate of silver and sulphate of copper, when in the presence of albuminous compounds, is similar in kind, it differs, nevertheless, essentially in degree, and it is upon this difference of degree that the peculiar virtues of each remedy depend, and which prevents their being used indiscriminately, one for the other, with the best effect.

The result, then, of my own observation has been that each of the above remedies has its peculiar virtues, dependent on its peculiar chemical and physiological action, which render them applicable to different diseases, or different degrees of the same disease, and that the nitrate of silver is superior to the sulphate of copper—

(1.) In acute catarrh, in purulent and gonorrhoeal conjunctivitis, and that of new-born children, when the first violence of the inflammation has passed, when there is much hypertrophy of the papillae and surrounding tissue, and much swelling of the lids, accompanied by an abundant purulent discharge.

(2.) When an acute attack of purulent or gonorrhoeal ophthalmia has passed, leaving behind it a general relaxation, with much hypertrophy of the tissues, and when the epithelial layer is much thickened. The nitrate is useful here as elsewhere in removing the morbid collections and in giving tone to the vessels and tissues, though it should not be repeated often.

(3.) In acute granular conjunctivitis, where the granulations acting, on account of their size, as a foreign body, have occasioned a general conjunctivitis, with hypertrophy of the papillae, accompanied with swelling of the lids and some discharge. Here it should be discontinued as soon as the acute symptoms have passed.

(4.) In diphtheritic conjunctivitis but very rarely, and only when the vascularity of the part has been re-established, when the epithelial layer is unhealthy, and where nature is evidently laboring to throw off the morbid exudations in the tissues.

The sulphate of copper is superior to the nitrate of silver—

(1.) In acute conjunctivitis, where the secretion is scanty and where there is but little hypertrophy of the papillæ and the cellular tissue, and but little alteration of the epithelial layer.

(2.) When acute conjunctivitis becomes chronic—a condition where the nitrate may be occasionally used in combination with it.

(3.) In chronic granular conjunctivitis, especially in trachoma when the mucous membrane seems to be deficient and the epithelial layer thin, and when a tendency to cicatrization of the tissue exists. Here, also, the nitrate may be used occasionally, whenever the epithelial layer is increased in thickness and the granulations appear large and florid.

(4.) In a relaxed condition of the conjunctiva or subconjunctival tissue from whatever cause, where moderate but continued stimulation is required.

Among the varieties of conjunctivitis for the treatment of which both of the above remedies would appear contra-indicated, may be mentioned the following:—

(1.) In simple hyperæmia of the conjunctiva, and in simple catarrhal conjunctivitis, where milder astringents are more advantageous.

(2.) In the latter stages of purulent or gonorrhœal conjunctivitis, when the circulation has been so much interfered with that stasis is liable to occur—a condition in which all astringents are extremely injurious.

As different diseases of the same class must necessarily run into each other, and as no distinct line can be drawn between different phases or degrees of the same disease, no absolute rule for the use of either of the above remedies can be laid down; still, I cannot help thinking that the above classification represents, in a general way, the cases to which the virtues of each remedy are applicable, and that their peculiar therapeutical merits will be found to depend on their respective chemical and physiological properties.

THE BOSTON MEDICAL AND SURGICAL JOURNAL.

BOSTON: THURSDAY, JULY 27, 1865.

The following letter from a distinguished member of our profession, now absent in South America, will most acceptably to our readers replace any disquisition, inevitably labored as it would be in the tropical temperature of the present week, which we could possibly offer them. Its statements with regard to one of the great destroyers of the human race will create some surprise, directly antagonistic as they

are to some current beliefs in this community at the present time. They do not, however, in our judgment, invalidate the deductions from patient and extensive observation here, but only tend to show that in different localities, under widely different social and climatic conditions, the same morbid processes may be set up. We also feel that positive statements, even of intelligent and reliable physicians, as to probable causes of disease, unless based on statistical research and study, with special reference to what in other localities such research has almost demonstrated as the main cause there, should not be allowed the same weight in deciding the general question. The letter was written, as will be seen, on the day of the anniversary meeting of the Massachusetts Medical Society, and by the gentleman, Dr. Cotting, whose address was read to the Society on that day by the Fellow to whom the letter was written.

DR. R. M. HODOES.

{ RIO DE JANEIRO, May 31, 1886.
12—2, P.M. (Boston time).

MY DEAR DOCTOR,—In this "far-off land where endless summer reigns," and rains often, as now, so copiously that to cross the street one must hire a negro slave to carry him in arms (price one "dump," equivalent to a penny), even here, so far off, the return of *this hour* carries one's thoughts back to his own land, where now, perhaps in sleety breezes, the members of our profession are assembling with a nobler zeal for their calling, and a friendlier interest in each other, than has ever yet been known among their brethren of this warmer clime. If I could send you a toast for the pleasanter portion of to-day's exercises, one that would embody the result of a short experience here, I would give: The continued and lasting prosperity of our medical societies—the dignity of the profession is not more truly sustained by the scientific attainments of individual members than by their frequent meetings for professional and friendly intercourse with one another.—In these regions medical societies are unknown; social gatherings are unheard of. The government looks after the profession—fining irregular practitioners when complained of, and regular ones when riding too fast on horse-back to their patients—one may ride at any speed in a vehicle drawn by as many mules as he chooses. Heretofore great jealousy has existed towards foreigners, who, as a rule, have been better educated and superior to native practitioners. This, however, is now passing off, and a better feeling begins to prevail, to the advantage of both parties. Means for professional study have been increased, and local instruction for students is said to be ample and thorough—as much so as in schools elsewhere. Hospitals are sufficiently numerous, and some are not surpassed in any country—for instance, the Don Pedro II. Asylum for the Insane; and the Misericordia, a general hospital, at Rio. The new portions of the latter are remarkable, surpassing any of the kind I have ever seen, in order, neatness, freedom from odors, arrangement and general appearance of the wards. Large, long, high-ceiled rooms, with numerous windows opening to the floor, little iron bedsteads, clean bedding, with bright red blankets nicely folded at the foot of each, perfectly white walls, waxed and polished floors, and doors also, of the beautiful woods of the country, long parallel corridors, court-yard gardens fitted with walks and shaded seats—all give an air of unsurpassed elegance to this home of the

afflicted. Nor will one be disappointed in the details of the establishment, over which Sisters of Charity (all from France, I believe) preside with their accustomed and proverbial devotion.

On inquiring what diseases prevail most, I was surprised to learn that tubercular consumption is by far the most frequent disease, not only at Rio, but throughout the Empire. This has been the unanimous reply of medical men here, and from other parts of the country, both native and foreign. Some rate the proportion of deaths as high as one in four, others one in six or seven, of the whole number from all causes. As to the cause of the disease the answer is, on the one hand comparatively luxurious living and mental anxiety to obtain it, and, on the other, the insufficient supply of animal food and its poor quality; intemperance; and harder work than formerly of the free laborers, &c. &c. The heat of the climate is also considered and emphasized as a principal cause; but on my asking if moisture had not something to do with it, I was answered that, on the contrary, moisture has been diminishing during the thirty years past, while phthisis has been at the same time on the increase. Moreover, the disease has been known to select certain houses or spots remarkable for their healthy position in other respects, removed from water-courses or dampness, in every way unobjectionable, and seize upon every family that dared to occupy such places, through a series of years, until these residences were abandoned and left to ruin through fear of an inevitable attack. Other instances have been known where the disease has occurred in attendants on the sick in such lengthened series as to give rise to a popular belief that it can be communicated from one person to another. Indeed, a prominent physician of Bahia maintains that it is as contagious as smallpox, and brings no small array of facts in support of his argument. What will be said to this by our friends who loudly denounce those who cannot see with their theory-tinted spectacles? Here are facts noted by gentlemen who have no hypotheses to support. They notice that the disease has been on the increase, while the atmosphere has at the same time become more dry; that the worst places have not been in the neighborhood of water, nor such as have been subject to fogs or dampness; while they admit their inability to explain fully its frequency or its increase. Surely such a world-spread disease must have some other origin than one to be indicated by the thermometer or gauged by the drosometer.

While phthisis is so common here, all aver that pneumonia and pleurisy are comparatively unknown—one eminent practitioner saying that in twenty years he had not seen more than four or five cases. Dysentery and diarrhoea are not very frequent. Most practitioners "rely on the calomel practice" in these complaints—other treatment not being so well borne. Elephantiasis and lepra figure largely among skin diseases hereabouts, especially such cases as come to the hospitals, one of which is devoted to their treatment. Hydrocele is also a very common affection. In the streets can be seen at any time numbers of negroes, knock-kneed and otherwise distorted; made so by the great burdens they carry on their heads, and perhaps also by the way they are themselves carried when infants—astride their mothers' backs. I once saw a negro slave carrying a barrel of sugar on his head!

But as I did not come to Brazil to study its diseases, I will not

longer trouble you with such matters. I will merely add a word or two concerning our own party. Since entering the tropics, nearly all have experienced some discomfort or disorder; three or four have been, temporarily, quite ill. One, the conchologist, though convalescent, will return by the first direct opportunity. Another, zoölogist, who has had an attack of varioloid, will leave for Europe, homeward bound, on the first steamer suiting his convenience. Whither, also, may go your humble servant, unless health, which has suffered materially, soon alters for the better. The chief discomforts have arisen from derangements of the digestive organs—an indescribable lassitude, a difficulty of progression which requires the utmost effort of a reluctant will to overcome, a leaden heaviness of the feet, with a confused aching of the head on any continued exertion—and occasionally strong indications of fever. But all these have been mostly overcome by prudence, or have nearly passed off spontaneously. Notwithstanding these partial drawbacks, the country hereabouts has been examined pretty thoroughly, by some or other of us to a distance of nearly two hundred miles into the interior. The flora and fauna are so very different from those of the North, that Prof. Agassiz seems quite overtaken in the multitude of interesting objects presented to his observation; and specimens have been collected thus far sufficient of themselves, one might say, to nearly make up a cargo. He has already made out over twenty new genera and species of fishes—a notable circumstance when it is remembered that his first great work was the classification and description of fishes collected in Brasil by Spix and Von Martius. Many leading citizens, including the Emperor himself, take great interest in the Professor's investigations. By the way, the Emperor is truly a very remarkable man. He is more a student than a ruler; a philosopher rather than a leader. Well posted in science, he questions quite closely those he sends for, on their special subjects, the latest discoveries and discussions—men and things. For instance, he asked the other day about your ether question, the comparative dangers of ether and chloroform, and also the operation of tracheotomy. He often sends for Prof. Agassiz, and offers him varied and valuable assistance in furtherance of his journey and the great object he has at heart.

But I must stop, or else you will have reason for wishing that I had remained at home to save you from reading my long-spun letter.

Kind remembrances to our professional and other friends,

Yours faithfully,

B. E. Cerrine.

PLURAL BIRTHS.—*The Medical and Surgical Reporter* publishes a case of plural births, occurring in the practice of Dr. H. H. Lowrie, of Washington, D. C. The mother, aged 36 years, has had four previous children in single births, unattended by any unusual circumstances. At the time of the present labor she was enormously enlarged, the whole lower part of the body and the lower extremities being of more than twice their natural proportions. She measured "around the abdomen, on a level with the umbilicus, 84 inches; around the knee, 38 inches; around the calf, 27 inches; and around the foot, directly over the junction of the phalanges and metatarsal bones, 20 inches. The skin was shiny from tension, and so rigid that it did not dent at

all upon pressure." She was delivered of four female children, three of which lived from one to fifteen minutes; the last was stillborn. The amount of liquor amnii was enormous; in the words of the reporter, it "gushed out with the force of water from a pump, and continued to rush with almost unabated force the whole time of the discharge. I caught six gallons of the waters, but much more was discharged, as the bed, coverlids and floor were completely saturated. There was no difference in the color and character of the waters from those passed generally in natural labor." It is stated that there were but two placentas, from one of which one cord arose, from the other three. From the size of the children, Dr. Lowrie estimated the age of the fetuses to be about six and a half months. The size of the woman ten days after delivery was "58 inches around the abdomen; 18 inches around the knee, calf, and foot respectively, the last being measured at the same point from which measurement was given above." At the time the case was reported she was doing well, although there had been much uterine hemorrhage.

HARVARD MEDICAL SCHOOL.—The following is a list of the gentlemen who received their medical degrees on the 19th inst., with the subjects of their dissertations:—

Name and Residence.

Charles John Blake, Boston,
Franklin Whitney Brigham, Shrewsbury,
Joseph A. Belden, U. S. Navy,

John Thomas Cameron, Prince Edward's Is'd, Periodic Fever.
Richard J. F. Goodwin, Boston,
Alfred Leonard Haskins, A.B., Boston,

Charles Edward Inches, A.B., Boston,
Amos Howe Johnson, A.B., Middleton,
Ole Henry Johnson, A.B., Haverhill,
Vincent Elijah Keegan, Roxbury,
John Han McDonald, Belfast, P. E. I.,
George Edward Mason, Providence, R. I.,

Horace George Miller, Pawtucket, R. I.,

Elison Groves Minomian, Lowell,

Charles Henry Page, U. S. Navy,

Isaac Newton Parley, Ayfield,

Charles Burnham Porter, A.B., Boston,

George Herman Powers, A.B., Boston,

Daniel Livingston Randall, Boston,

Charles Edward Sanborn, Winchester,

Edward Sawyer, Boston,

George Grosvenor Tartell, A.B., Lincoln,

Oliver Fairfield Wadsworth, A.B., Boston,

Samuel Gilbert Webber, A.B., West Newham,

Edward Wigglesworth, Jr., A.B., Boston,

William Woods, Boston,

Thesis.

Disinfectants.
Mind and Body.
Bilious Remittent Fever of the West
Coast of Mexico.

Gun-shot Wounds.
Anatomy and Physiology of the
Liver.

Cystitis.

Scrofula.

Scurvy.

Dietetics.

Quinine.

Causes and Treatment of Ununited

Fractures.

Hypermetropia.

Diphtheria.

Dengue.

Varicella.

Compound Fracture of the Femur.

Mechanism of Expiration.

Scarlatina.

Hospital Gangrene.

Province of the Art of Healing.

Camp Diseases.

Pemphigus.

Dengue.

Classification of Venereal Disease.

Typhoid Fever.

GEORGE CHENEY SHATTUCK, M.D.,
Dean of the Medical Faculty.

July 21st, 1865.

The thirteenth annual meeting of the American Pharmaceutical Association will be held in Boston, on Tuesday, Sept. 5, at 3 o'clock, P.M.
The British Pharmaceutical Conference will meet in September, in the city of Birmingham. The *Pharmaceutical Journal* for June con-

tains a list of the subjects of inquiries which are expected to be answered on that occasion; about fifty in number.

Governor Curtin has appointed Brigadier General Horatio G. Sickel, who has faithfully served in the Army during the past four years, to the position of Health Officer in Philadelphia.

The British Association for the Advancement of Science will hold its sessions this year at Birmingham, under the Presidency of Professor Phillips.

The physicians of St. Mary's County, Maryland, met at Leonardtown, on the 9th of May last, and formed a Society, under the title of the "Medico-Chirurgical Society of St. Mary's County."

The following-named medical officers have been announced as Quarantine Officers for the several ports set opposite their respective names:—Assistant Surgeon E. K. Hogan, United States Volunteers, Tybee Roads, Ga. Assistant Surgeon Alexander Lelong, United States Volunteers, Fernandina, Fla. Assistant Surgeon E. D. Buckman, United States Volunteers, Charleston, S. C. Assistant Surgeon Walter R. Way, United States Volunteers, Port Royal Harbor, S. C.

The Miami Medical College, at Cincinnati, has recently been reorganized, and preparations are being made by which a most thorough course of medical instruction will be given. A large and very strong corps of professors has been elected to fill the various chairs.

The Annual Announcement of the St. Louis Medical College is before the public. This is a first class institution, its chairs filled by men of experience and eminent as teachers. All the usual facilities are abundant here.

VITAL STATISTICS OF BOSTON.

FOR THE WEEK ENDING SATURDAY, JULY 23D, 1865.

DEATHS.

	Males.	Females.	Total.
Deaths during the week	51	63	114
Ave. mortality of corresponding weeks for ten years, 1853—1863,	42.5	39.0	81.5
Average corrected to increased population	60	60	90.31
Death of persons above 90	0	1	1

PAMPHLETS RECEIVED.—Medical Communications, with the Proceedings of the Seventy-third Annual Convention of the Connecticut Medical Society, held at Hartford, May 24th and 25th, 1865.

MARRIED.—At Chelmsford, June 29th, Charles Dutton, M.D., of the Illinois State Hospital, to Miss Mary E. Perham, of Chelmsford.

DIED.—At Washington, D. C., on the 5th inst., Dr. Bela N. Stevens, of New Hampshire, First Assistant Physician at the Government Insane Asylum, Washington, D. C.

DEATHS IN BOSTON for the week ending Saturday noon, July 23d, 114. Males, 51—Females, 63. Accident, 1—apoplexy, 4—congestion of the brain, 1—disease of the brain, 5— inflammation of the brain, 4—bronchitis, 3—cancer, 2—carbuncle, 1—cholera infantum, 17—cholera morbus, 1—consumption, 13—convulsions, 3—croup, 1—diarrhea, 2—diphtheria, 1—dropsy, 2—dropsy of the brain, 6—drowned, 1—dysentery, 9—scarlet fever, 1—typhoid fever, 5—hemorrhage, 2—disease of the heart, 2—infantile disease, 3—interperence, 2—disease of the kidneys, 2—congestion of the lungs, 1—inflammation of the lungs, 1—marasmus, 1—measles, 1—old age, 1—paralysis, 2—peritonitis, 1—puerperal disease, 1—scrofula, 1—smallpox, 1—unknown, 6—whooping cough, 2.
Under 5 years of age, 57—between 5 and 20 years, 10—between 20 and 40 years, 30—between 40 and 60 years, 14—above 60 years, 13. Born in the United States, 85—Ireland, 21—other places, 8.

